

What is Claimed Is:

1. An apparatus for treating surfaces of a single workpiece with ultrasonic energy, comprising:

(a) a chamber defining an interior space for containing therein a liquid, said chamber comprising a bottom wall and a first pair of opposing, longitudinally extending sidewalls connected by a second pair of opposing, transversely extending sidewalls;

(b) an ultrasonic wave energy applying means for supplying ultrasonic wave energy to a liquid contained within said interior space of said chamber, said ultrasonic wave energy applying means including a planar transducing surface forming at least a portion of a first one of said second pair of opposing, transversely extending sidewalls; and

(c) a workpiece mounting means within said interior space of said chamber for mounting therein a single workpiece, said workpiece mounting means comprising means for mounting a single workpiece comprising a pair of opposed, planar surfaces, such that said pair of opposed, planar surfaces are oriented perpendicularly to said planar transducing surface of said ultrasonic wave energy applying means for simultaneously receiving therefrom ultrasonic energy.

2. The apparatus according to claim 1, wherein:

said workpiece mounting means (c) comprises means for mounting a disc-shaped substrate.

3. The apparatus according to claim 1, further comprising:

(d) an acoustic waveguide means at least partially surrounding said planar transducing surface of said ultrasonic wave energy applying means for increasing the power density of ultrasonic energy supplied to said liquid.

4. The apparatus according to claim 1, further comprising:

(d) ultrasonic energy reflecting means located within said interior space.

5. The apparatus according to claim 4, further comprising:

(e) movable partition means transversely extending at least partway between said first pair of opposing, longitudinally extending sidewalls for adjustably partitioning said interior space into first and second sub-spaces each extending for a desired, adjustable length along said first pair of longitudinally extending sidewalls, said movable partition means being comprised of a material which is partially reflective and partially transmissive of ultrasonic wave energy; and

said workpiece mounting means (c) is adapted to be selectively positioned in either said first sub-space or said second sub-space.

6. The apparatus according to claim 5, wherein:

said movable partition means (e) comprises a sheet of a polyurethane material.

7. The apparatus according to claim 5, wherein:

said ultrasonic energy reflecting means (d) comprises said second one of said second pair of transversely extending, opposing sidewalls for reflecting ultrasonic energy back to said movable partition means.

8. The apparatus according to claim 5, wherein:

said ultrasonic energy reflecting means (d) comprises a contoured surface ultrasonic reflector for reflecting ultrasonic energy away from said movable partition means and onto an ultrasonic energy absorbing means within said interior space, thereby increasing the formation of progressive ultrasonic energy waves within said interior space while decreasing the formation of standing ultrasonic energy waves.

9. The apparatus according to claim 1, further comprising:

(d) workpiece supplying/withdrawal means for inserting said workpiece mounting means into said interior space and for withdrawing said

workpiece mounting means from said interior space after a predetermined
5 interval for treatment of a said workpiece.

10. The apparatus according to claim 1, further comprising:

(d) liquid supply means including recirculation and filter means for
recirculating and filtering a liquid in said chamber and/or for supplying fresh
liquid to said chamber.

11. A system comprising a plurality of ultrasonic energy treating
apparatuses of claim 1 fluidly connected in parallel.

12. A method of treating a single workpiece having a pair of
opposed, planar surfaces with ultrasonic energy, comprising the steps of:

(a) providing an apparatus comprising:

5 (i) a chamber having an interior space containing therein a
liquid, said chamber comprising a bottom wall and a first pair of
opposing, longitudinally extending sidewalls connected by a second
pair of opposing, transversely extending sidewalls;

10 (ii) an ultrasonic wave energy applying means for
supplying ultrasonic energy to said liquid in said chamber, said
ultrasonic wave energy applying means including a planar transducing
surface forming at least a portion of a first one of said second pair of
opposing, transversely extending sidewalls; and

15 (iii) a workpiece mounting means positioned within said
interior space of said chamber for mounting therein a single workpiece
comprising a pair of opposed, planar surfaces, such that said pair of
surfaces are oriented perpendicularly to said planar transducing surface
at a preselected spacing therefrom;

20 (b) positioning within said interior space a said workpiece
mounting means having a said single workpiece, such that each of said pair of
workpiece surfaces is in contact with said liquid; and

(c) applying ultrasonic energy from said planar transducing surface to said liquid for simultaneous treatment of each of said pair of workpiece surfaces.

13. The method as in claim 12, wherein:

step (c) further includes reflecting ultrasonic energy applied from said planar transducing surface to said liquid via reflective means located within said interior space.

14. The method as in claim 13, wherein:

step (a)(i) further comprises providing a movable partition means within said interior space, said movable partition means extending transversely at least partway between said first pair of opposing, longitudinally extending sidewalls for adjustably partitioning said interior space into a first sub-space including said planar transducing surface and a second sub-space including said second one of said second pair of opposing, transversely extending sidewalls, each of said first and second sub-spaces extending for a desired, adjustable length along said first pair of longitudinally extending sidewalls, said movable partition means being comprised of a material which is partially reflective and partially transmissive of ultrasonic energy; and

step a(iii) further comprises positioning said workpiece mounting means in either said first sub-space or said second sub-space at a spacing from said transducing surface which provides said pair of substrate surfaces with a desired amount of ultrasonic power.

15. The method as in claim 14, wherein:

step (c) comprises reflecting said ultrasonic energy back to said movable partition means.

16. The method as in claim 14, wherein:

step (c) comprises reflecting said ultrasonic energy away from said movable partition means and onto an ultrasonic energy absorbing means located within said interior space, thereby increasing the formation of

- 5 progressive ultrasonic waves within said interior space while decreasing the formation of standing ultrasonic waves.

17. The method as in claim 14, wherein:

step (a)(i) comprises providing a movable partition means comprising a sheet of a polyurethane material; and

- 5 step (a)(iii) comprises positioning said workpiece mounting means within said second sub-space.

18. The method as in claim 12, wherein:

step (b) comprises providing a disc-shaped substrate.

19. An apparatus for treating surfaces of a single workpiece with ultrasonic energy, comprising:

- (a) a chamber comprising a bottom wall and a plurality of pairs of planar sidewalls, said chamber including a planar ultrasonic transducing surface forming at least a portion of one of said sidewalls; and
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(b) means for mounting a single workpiece having a pair of opposed, planar surfaces such that said pair of surfaces are oriented perpendicularly to said planar transducing surface.

20. The apparatus as in claim 19, further comprising:

- (c) movable partition means within said chamber for adjustably partitioning said chamber into two sub-chambers and comprised of a material which is partially reflective and partially transmissive of ultrasonic wave energy; and
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(d) reflector means within said chamber for reflecting ultrasonic wave energy back to said partition means or to an ultrasonic energy absorber located within said chamber.